Stoller
Grand Junction Office established 1959

GJO-2004-546-TAC

C-4174
Log Data Report

Borehole Information:

Borehole: C-4174			Site: 216-B-58 Trench		
Coordinates (WA St Plane)		GWL[1] (ft): None		GWL Date: 12/10/03	
North	East	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
Not available	Not available	12/03	Not available	100	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	1.85	8 3/4	7 3/4	1/2	+1.85	100
Unknown	0.9	11 3/4	10 5/16	11/16	+0.9	30

Borehole Notes:

The logging engineer measured the casing stickup using a steel tape. A caliper was used to measure the outside casing diameters. The caliper and inside casing diameters were measured using a steel tape. Measurements are rounded to the nearest 1/16 inch. The Fluor Hanford drilling supervisor provided the casing depth. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 1G		Type:	SGLS (35%) SN: 34TP10967A
Calibration Date:	04/03	Calibration Reference:	GJO-2003-438-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

High Rate Logging System (HRLS) Equipment Information:

Logging System:	Gamma 1C		Type:	HRLS SN: 39-A314
Calibration Date:	04/03	Calibration Reference:	GJO-2003-429-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 2F		Type:	NMLS SN: H380932510
Calibration Date:	09/03	Calibration Reference:	GJO-2003-520-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	3	4 Repeat	5	6 Repeat	
Date	12/11/03	12/11/03	12/12/03	12/12/03	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	99.0	47.0	30.0	25.0	
Finish Depth (ft)	30.0	41.0	1.0	22.0	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A[2]	N/A	N/A	N/A	
Pre-Verification	AG032CAB	AG032CAB	AG033CAB	AG033CAB	
Start File	AG032000	AG032070	AG033000	AG033030	
Finish File	AG032069	AG032076	AG033029	AG033033	
Post-Verification	AG032CAA	AG032CAA	AG033CAA	AG033CAA	
Depth Return Error (in.)	N/A	-1	0	0	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	

High Rate Logging System (HRLS) Log Run Information:

Log Run	7	8 Repeat			
Date	12/12/03	12/12/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	17.0	13.0			
Finish Depth (ft)	9.0	11.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AC086CAB	AC086CAB			
Start File	AC086000	AC086009			
Finish File	AC086008	AC086011			
Post-Verification	AC086CAA	AC086CAA			
Depth Return Error (in.)	N/A	N/A			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 Repeat	9	10 Repeat	
Date	12/10/03	12/10/03	12/12/03	12/12/03	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	30.0	39.0	0.0	10.0	
Finish Depth (ft)	99.0	49.0	30.0	15.0	
Count Time (sec)	N/A	N/A	N/A	N/A	
Live/Real	N/A	N/A	N/A	N/A	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1	1	1	1	
Pre-Verification	BF137CAB	BF137CAB	BF138CAB	BF138CAB	
Start File	BF137000	BF137277	BF138000	BF138121	
Finish File	BF137276	BF137317	BF138120	BF138141	

Log Run	1	2 Repeat	9	10 Repeat	
Post-Verification	BF137CAA	BF137CAA	BF138CAA	BF138CAA	
Depth Return Error (in.)	N/A	0	N/A	N/A	
Comments	None	None	None	None	

Logging Operation Notes:

Logging was performed in this borehole on December 10, 11, and 12, 2003. Ten log runs were performed with three separate logging systems. These systems are referred to as SGLS 1G (4 log runs), NMLS 2F (4 log runs), and HRLS 1C (2 log runs). Measurements were acquired with each system in a single casing string (8-in.) from 30 ft to total depth of the borehole. The 8-in. casing was removed from the borehole and logging was conducted with each system from 0 to 30 ft in the remaining 12-in. casing. Logging was conducted with a centralizer on each sonde. Measurements are referenced to ground surface. Repeat sections were collected in this borehole for all systems to evaluate the logging system's performance.

Analysis Notes:

Analyst:	Henwood	Date:	12/16/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after data acquisition. Acceptance criteria were met for all systems except for the post verification file number AG033CAA (log runs 5 and 6 for the SGLS). The count rate for the 2615-keV energy peak was low relative to the acceptance criteria. This discrepancy suggests log data acquired during these log runs may underestimate the count rate of the higher energy peaks (e.g., greater than approximately 1800 keV). The only radionuclide of interest measured above 1800-keV energy level is the 2615-keV energy peak used to determine the naturally occurring ^{232}Th concentration. The concentration of this radionuclide may be underestimated by 15 percent or less.

A casing correction for 0.5-in.-thick casing (8-in. casing) was applied to the spectral log data (SGLS and HRLS) from 30 to 99 ft. From 0 to 30 ft, a correction for 0.72-in.-thick casing (12-in. casing) was applied. No correction for 12-in. casing is available for the NMLS. Consequently, moisture data are presented in counts per second and reflect relative moisture content.

SGLS and HRLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet templates identified as G1GMay03.xls and G1CApr03.xls for the HRLS using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. Correction for water was not needed in this borehole.

NMLS data were also processed in batch mode and volumetric moisture was calculated in an EXCEL worksheet using calibration data.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (^{137}Cs and ^{60}Co) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and moisture, and total gamma plotted with dead time. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. Neutron moisture log plots are provided that present volumetric percent moisture content for data acquired in the 8-in. casing from 30 to 100 ft and relative moisture content for the entire borehole in counts per second. Repeat log sections are also included where appropriate.

Results and Interpretations:

^{137}Cs was detected in this borehole between 8 and 31 ft. The maximum concentration was measured at approximately 32,000 pCi/g at 12 ft in depth. ^{60}Co was detected between 8 and 18 ft. The maximum ^{60}Co concentration is approximately 84 pCi/g at 11 ft in depth.

The repeat sections for the SGLS, HRLS, and NMLS indicate good agreement.

[1] GWL – groundwater level
[2] N/A – not applicable

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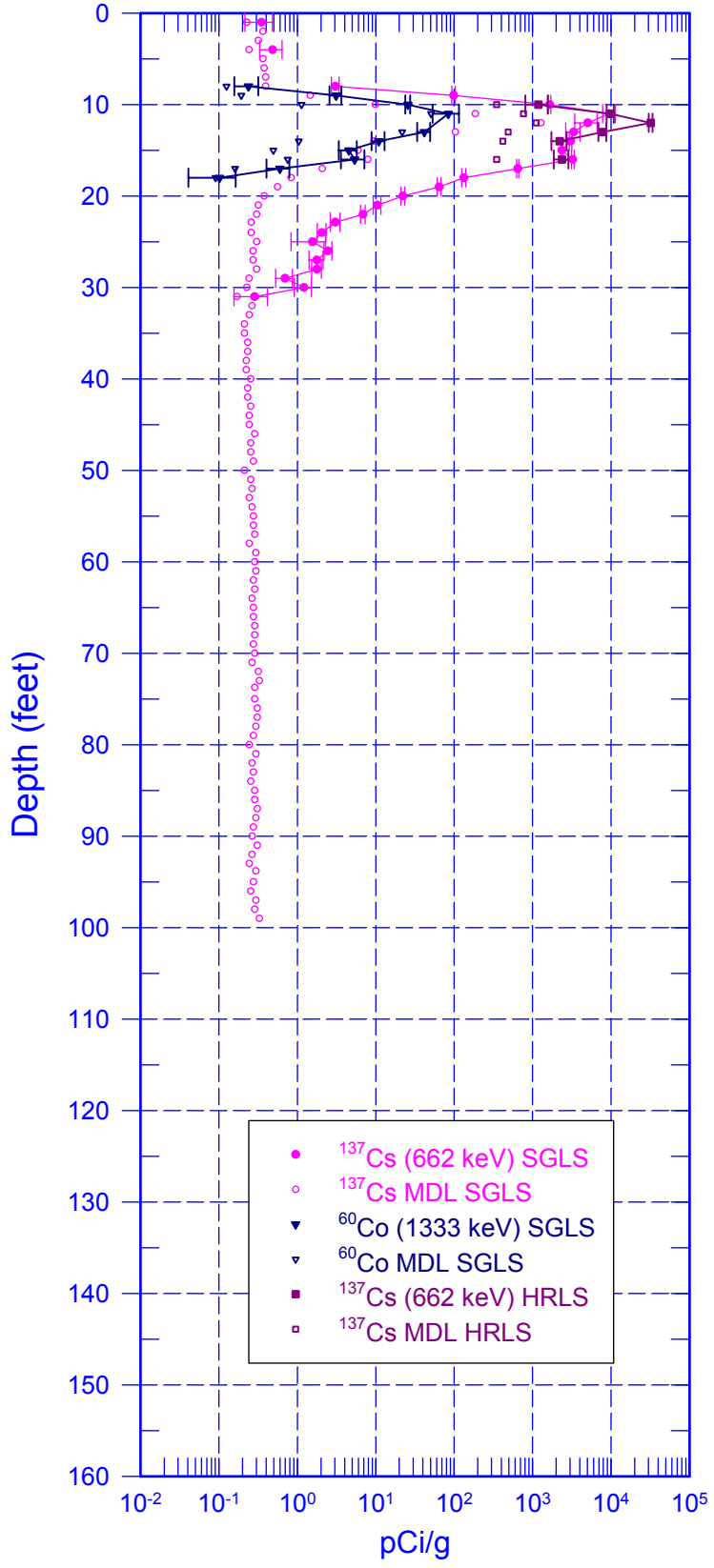
Man-Made Radionuclides



Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 12/12/03

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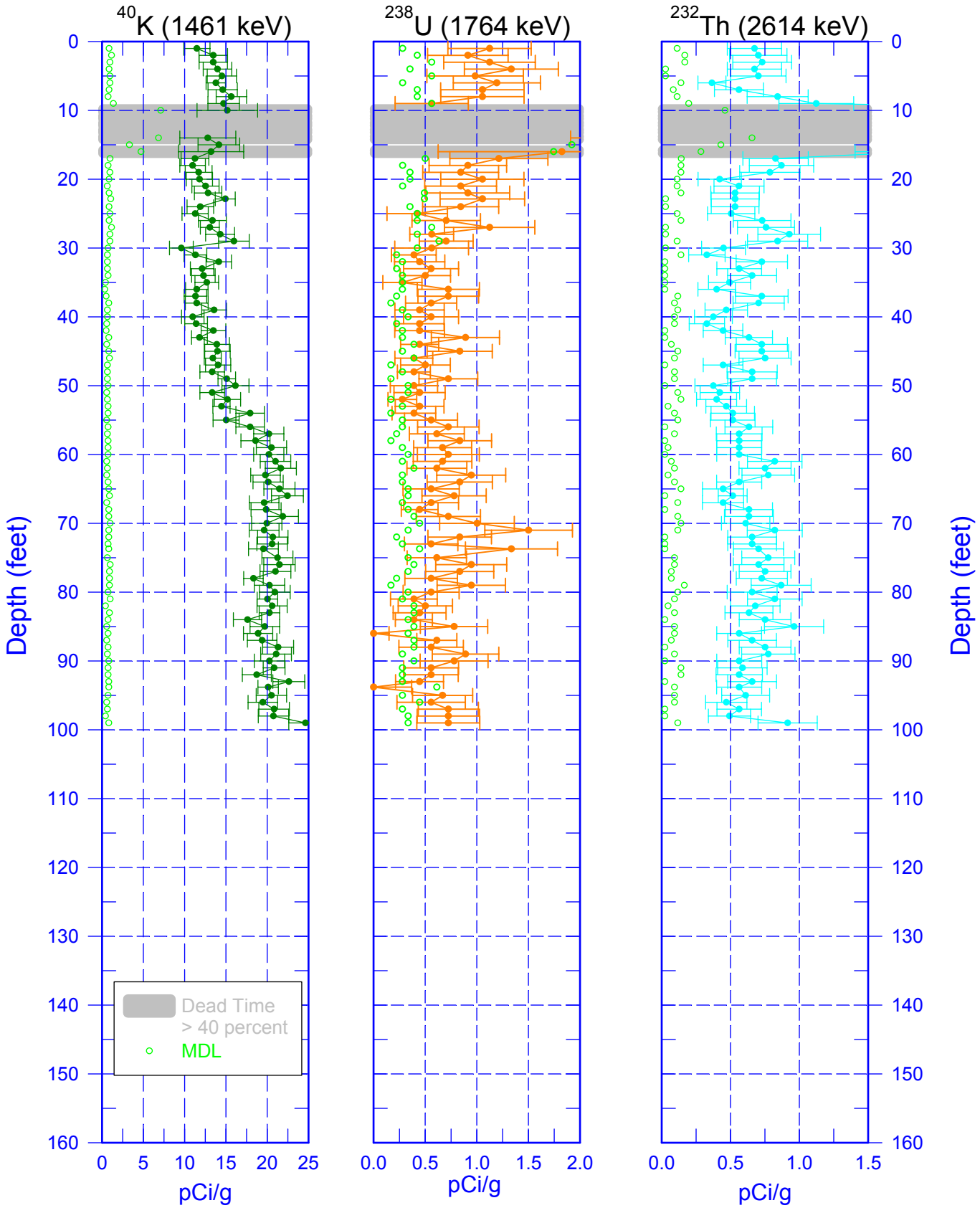
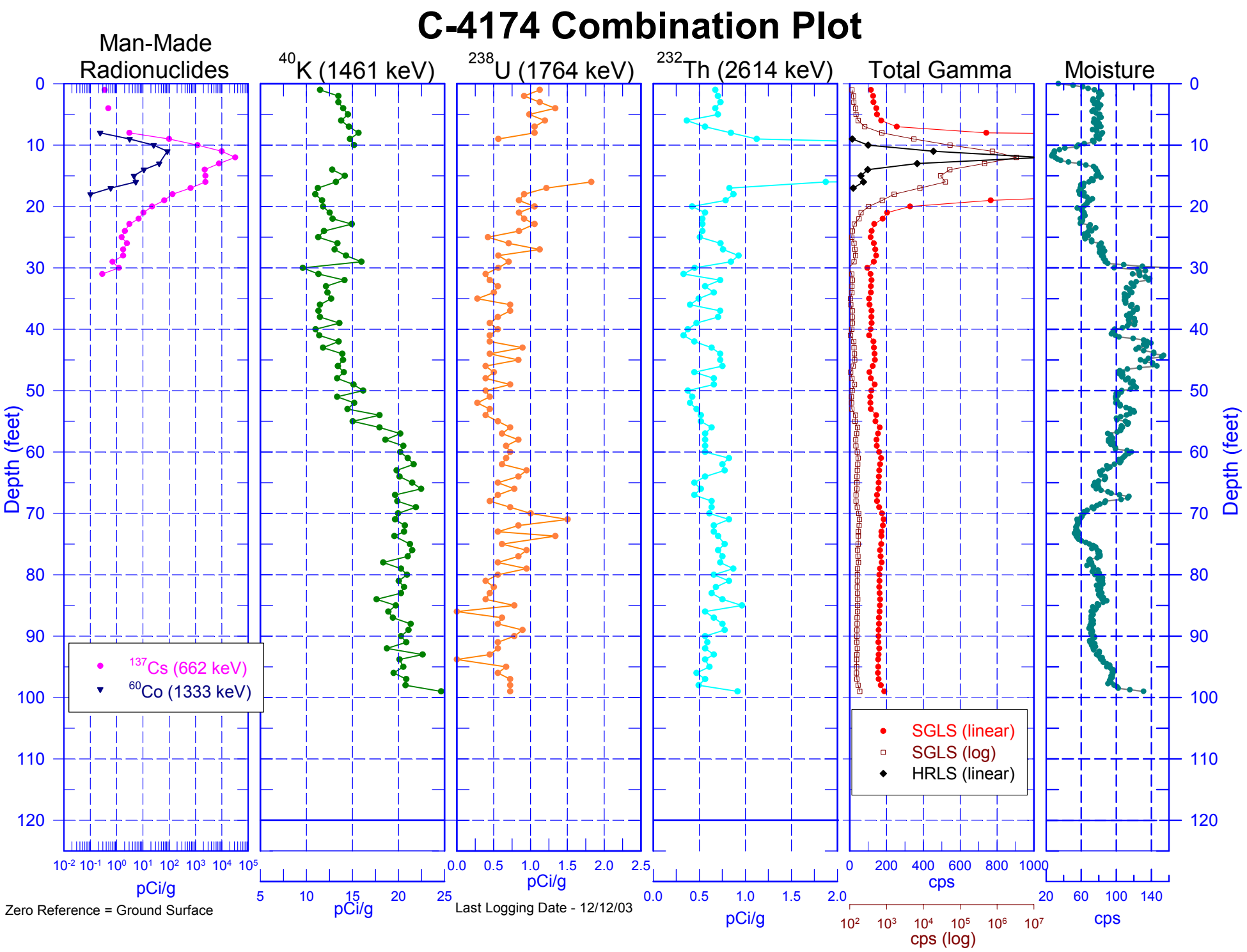
Natural Gamma Logs



Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 12/12/03


C-4174 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
137Cs (662 keV)
60Co (1333 keV)
SGLS (linear)
SGLS (log)
HRLS (linear)
pCi/g
cps
cps (log)
Zero Reference = Ground Surface
Last Logging Date - 12/12/03

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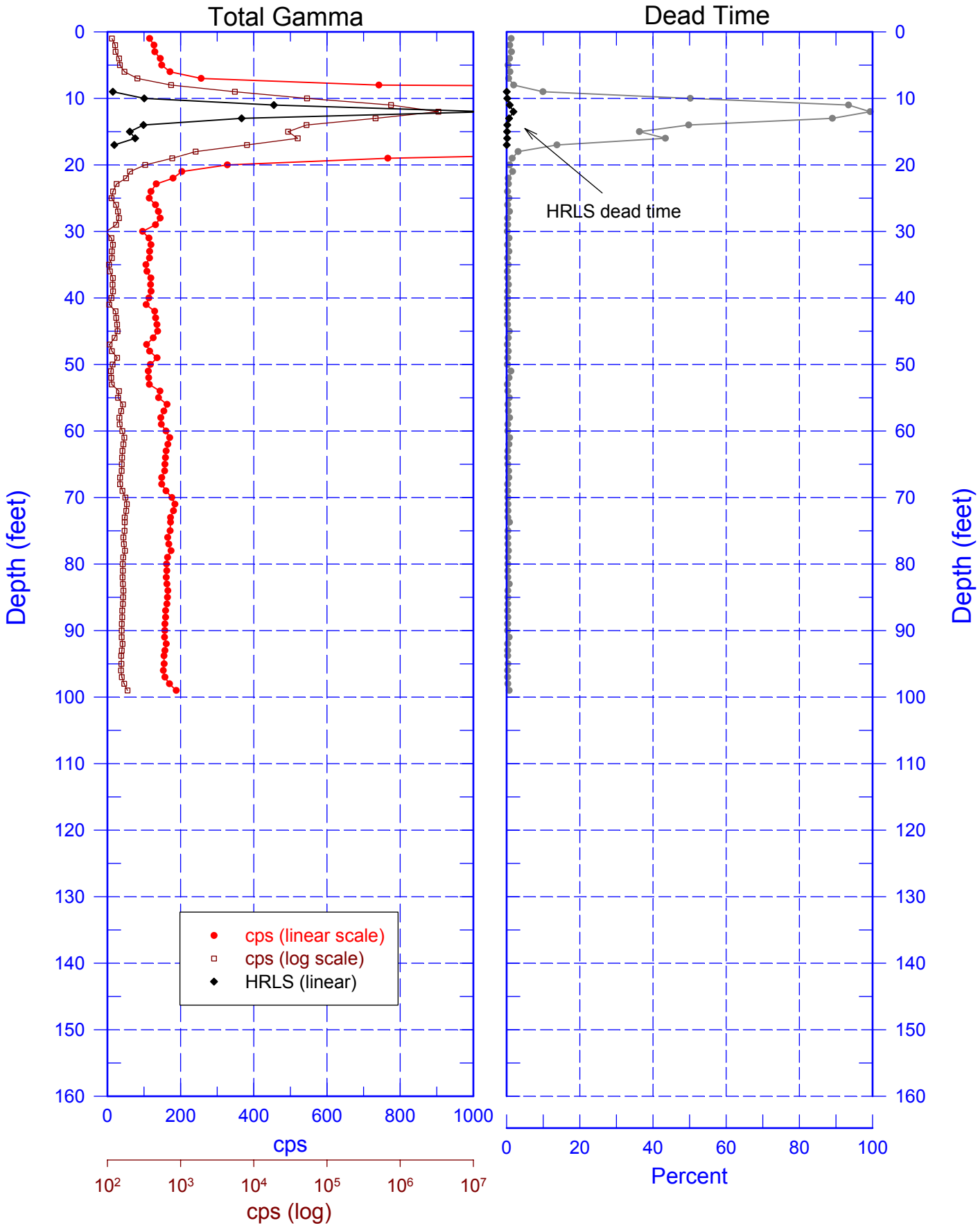
Total Gamma & Dead Time



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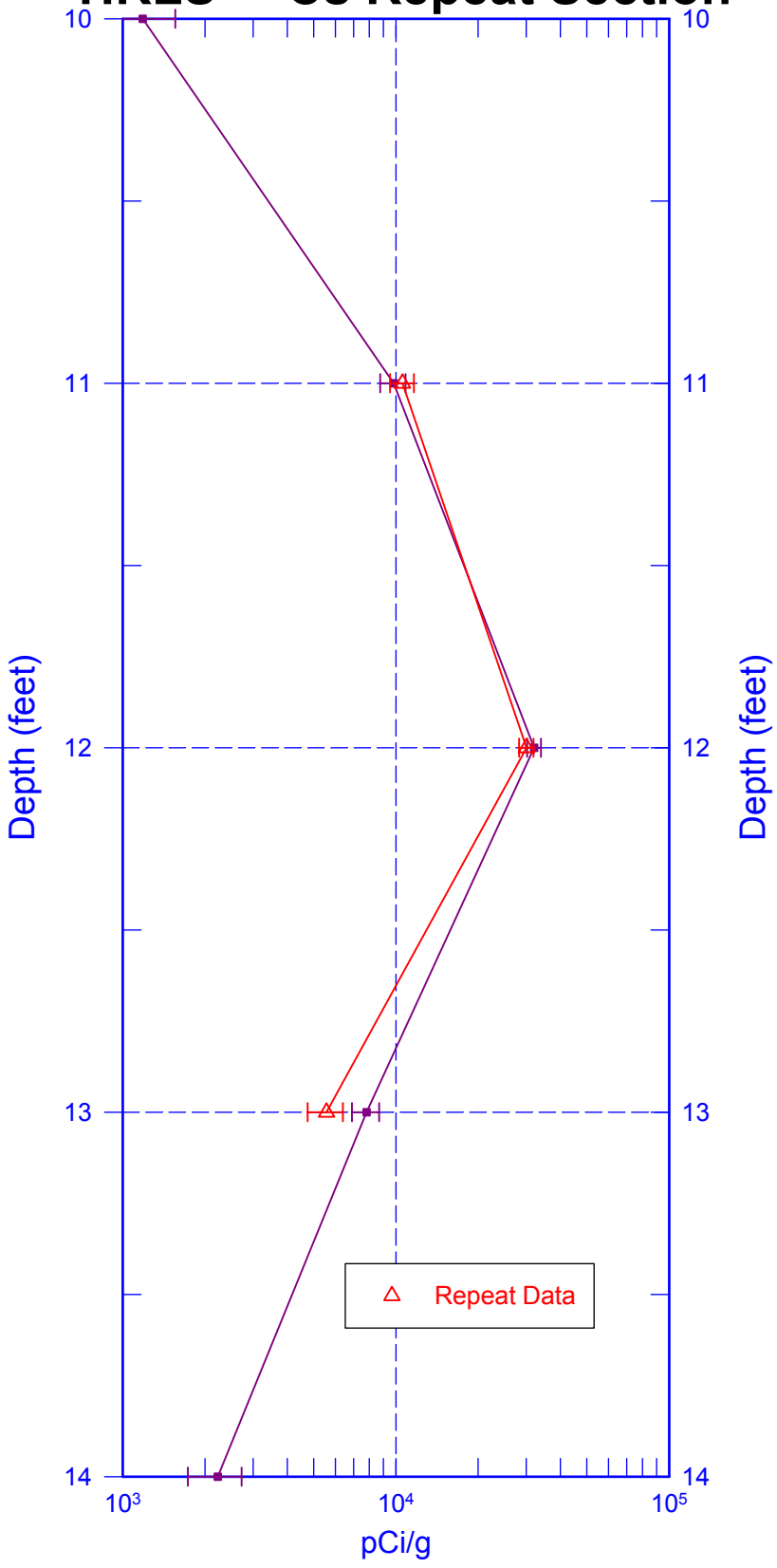
HRLS ^{137}Cs Repeat Section



Zero Reference = Ground Surface

Last Log Date - 12/12/03

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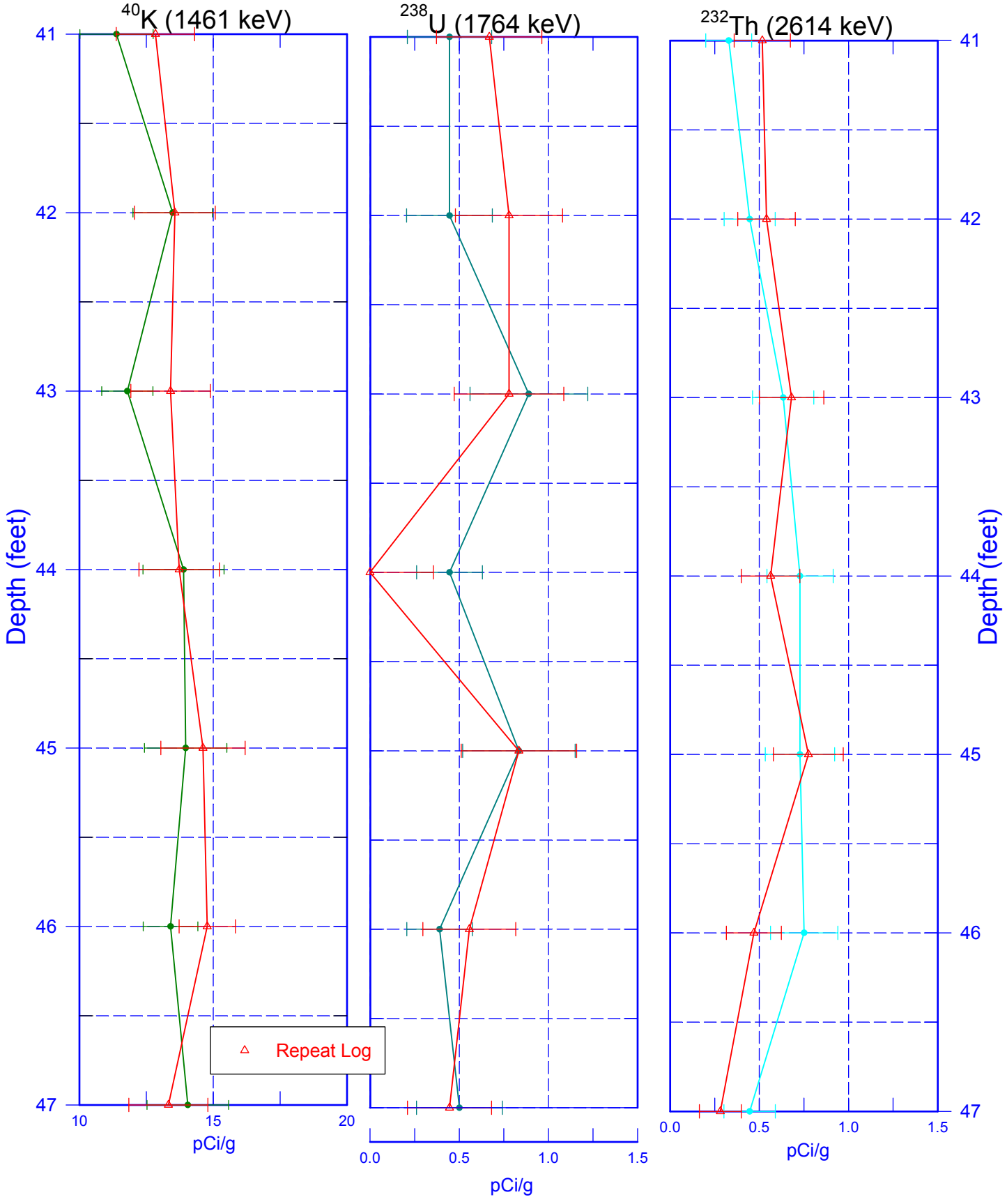
Repeat Section of Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 12/12/03

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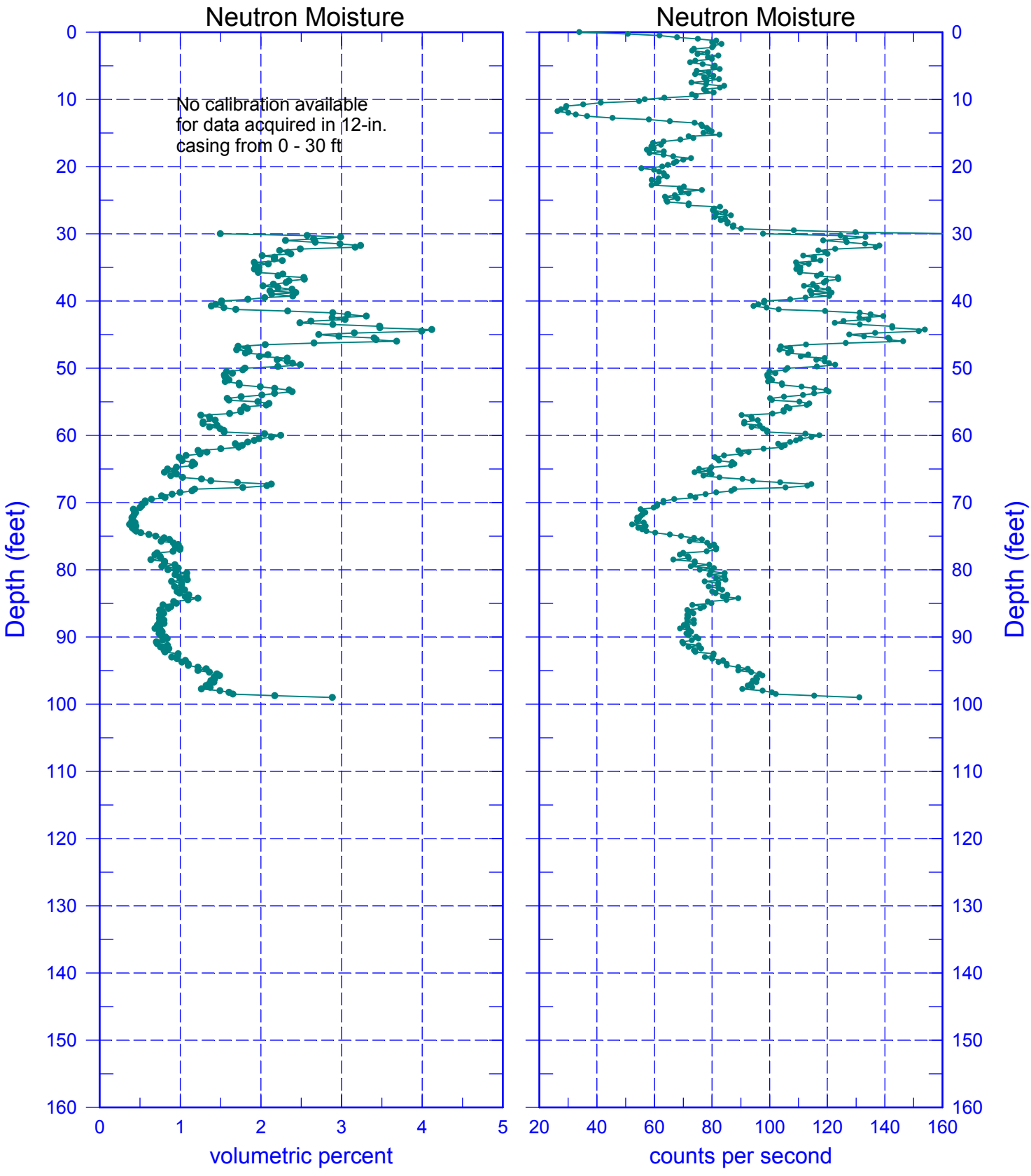

Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 12/12/03

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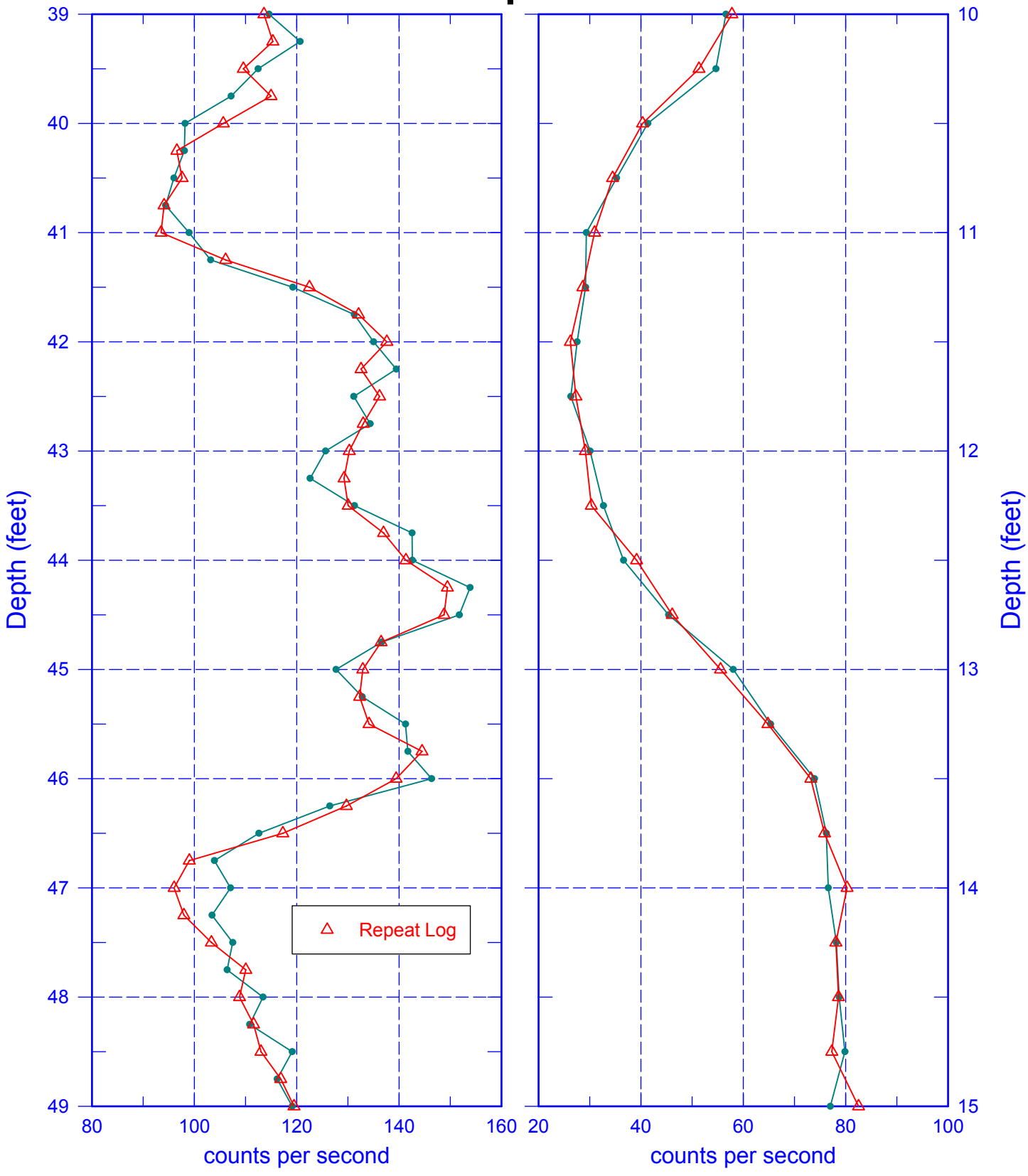
Moisture Repeat Sections



Zero Reference = Ground Surface

Last Log Date - 12/12/03

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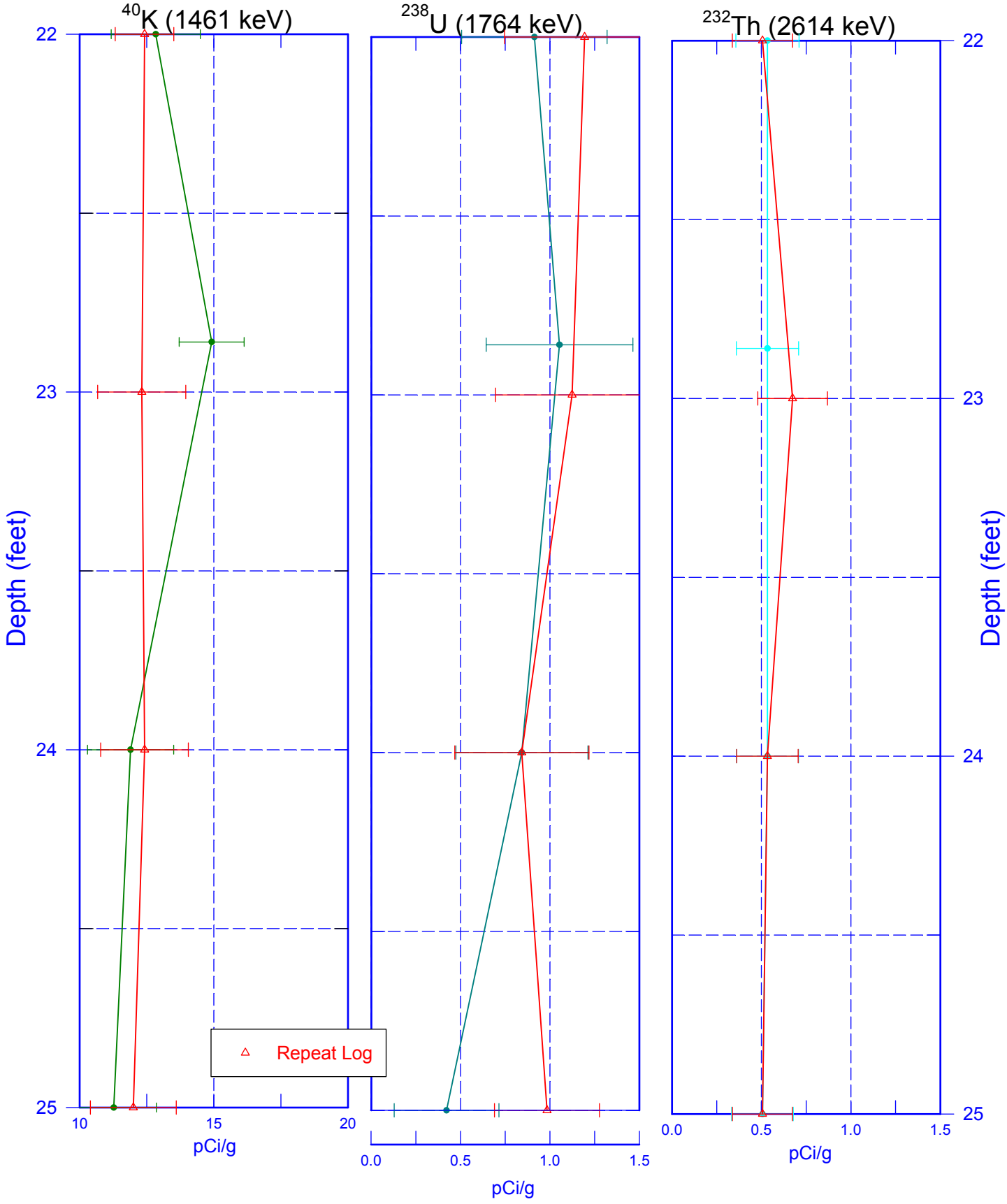
Repeat Section of Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 12/12/03